SENIOR SERVICE COLLEGE FELLOWSHIP RESEARCH PAPER

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RECAPITALIZATION OF TACTICAL COMPUTER AUTOMATION SYSTEMS

BY

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USAWC FELLOWSHIP RESEARCH PROJECT

Recapitalization of Tactical Computer Automation Systems

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ABSTRACT

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In early 1990 the Army made a conscience decision to leverage the development of "Commercial-*Off-The-Shelf* " (COTS) computer hardware and related components for integration into military applications. This decision was driven primarily by the growing cost of automation hardware developed to Military-Specifications (Standards) which were often seen as unjustifiable, usually exceeding the required operating threshold and far too costly to produce. Since that time, the Army has spent approximately $1B+ fielding tactical computer and automation hardware designed to enhance the field commander's situational awareness of the battlefield. Given today's budget constraints, the Army will not be able to rely on a continual flow of funds to reprocure hardware as the current generation of systems fail to keep up with the growing demands of software. In this light, the Army must begin to pursue alternatives toward extending the useful life of automation hardware already in the field.

Due to the ever-growing resource requirements needed to efficiently run multi-layered system software such as Unix (Operating System Software), the Army Battle Command System (ABCS) software suite and functional application

software (e.g. AFATDS, ASAS, MCS, etc) the Army is beginning to see limitations in the efficient operation of tactical computer hardware systems, particularly those systems fielded earliest. Most computer hardware currently fielded may not be able to continue to run efficiently in view of current software growth trends and the complexity related to increasing performance of fielded legacy systems. If left unchecked, this situation could have significant impact on the Army's transformation effort and timeline for fielding a fully digitized combat organization with a seamless C4I capability and unmatched lethality,

The intent of this paper is to lay out how the Army got to where it is today and hopefully delineate actions, which need to be taken now and in the future to keep this important effort on track. Please note that for the purpose of narrowing the scope of this project the author has focused on only the primary ABCS software applications which would include: Maneuver Control System (MCS), All Source Analysis System (ASAS), Advanced Field Artillery Tactical Data System (AFATDS), Forward Area Air Defense C2I (FAAD C2I) Combat Service Support Control System (CSSCS), Aviation Mission Planning System (AMPS), Digital Topographic Support System (DTSS), and the Army Battle Command System (ABCS) .

TABLE OF CONTENTS

Recapitalization of Tactical Computer Automation Systems

"The Department of Defense continues to face a limited investment budget constrained by a relatively stable top-line budget, and squeezed by increased operations and support cost for aging weapons systems." [1]

The current pace of "Commercial-Off-The-Shelf" (COTS) computer component migration is adversely affecting the projected useful life of the Army's new ruggedized tactical computer systems - accelerating planned rebuy/refresh funding points for Product/Program Managers and making it difficult to accurately work to develop cost effective recapitalization strategies for their fielded systems.

The purpose of this paper is two fold. First, it's to analyze and discuss the Army's implementation of Secretary of Defense William Perry's 1994 directive to integrate and leverage commercial-off-the-shelf components in the design and production of systems developed and procured by the Department of Defense (DoD). In this part of the discussion, the author intends to highlight the advantages and disadvantages of COTS components as they are integrated into today's tactical computers and automation hardware systems. The second purpose is to identify a number of recommendations (some obvious - some not so obvious) as to what can and should be done by way of recapitalization activities to get the most out of our current materiel investment. Whether referring to the activity as: *modernization, recapitalization, rebuild, rebuy, or refurbish,* the real question on the table from the Army leadership is: "What can be and is being done to extend the useful life of its $1B+ investment in tactical automated

systems supporting digitization and ultimately the Army's Transformation Program?"

In their book, War and Anti-War, Alvin and Heidi Toffler describe three waves of warfare. The first wave was *agrarian warfare* (Pre-1864), the second wave was *industrial warfare* (1864-1989), and the third wave is *information warfare*. Operation Just Cause and Desert Storm represent the first campaigns of this third wave. [2]

Since the end of Desert Storm, the Army and other DoD agencies (i.e. Marines, National Guard, Army Reserves, etc.) have procured well in excess of 10,000 computers, the majority of which were ruggedized and designed for use in the types of harsh environmental settings the user may be deployed to fight. This number reflects only those tactical computers built and delivered by way of the Army's Common Hardware Program, and does not reflect computers which may have been procured through a myriad of other contract vehicles. Therefore, the total number of tactical computers in operation today may well be in numbers of an even greater magnitude. The important point here is to demonstrate the immense proliferation of tactical automation systems used by the Army and sister services since it began in the late 1980s and early 1990s, as well as, the need for a plan to address recapitalization of this significant investment.

Background

In 1994, the Secretary of Defense, Dr. William Perry implemented an initiative that essentially moved the services toward a COTS approach to materiel

development. This initiative, an aspect of the Acquisition Reform Act, was promoted by DoD in order to contain military costs by eliminating the design of customized application-specific systems. Subsequently, the initiative forced the services to reduce their traditional reliance on military specifications for materiel acquisition and to seek out COTS solutions whenever and wherever applicable. Use of commercial standards and specifications were to become the norm, and subsequently the services were required to request special waivers for the use of Mil-Spec in procurement of items in the years that followed. The impetus for this initiative was clear. It was in DoD's best interest to leverage research, development and acquisition (RD&A) investments in the commercial sector, and in so doing, free up declining defense dollars for other pressing requirements such as combat system modernization, training, and procurement.

Since the end of the Cold War, U.S. defense spending has dropped 40% of what it was at its peak, and DoD's procurement budget is down by 65%.[3] Subsequently, military influence in the electronics and semiconductor market has been reduced proportionately. In the 1970s, the military purchased and controlled more than 30% of the electronics sector. By the mid-1980s, the military's share had fallen to approximately 7%. Today, DoD purchases less than 1% of the industry's total semiconductor output.[4] When the military lost its market share, it lost its influence. The bottom line is that today COTS development is driven by consumer need and commercial trends, and DoD is primarily a spectator, forced to leverage commercial technology developments

rather than direct them. This is a reality that apparently the Army and DoD user community has yet to fully accept!

What does that mean to the Army? On one hand military system developers love the low cost, cutting edge technology provided by way of COTS materiel integration; however, the major downside of COTS is the short obsolescence cycle and lack of corporate incentive to ensure the next generation component seamlessly integrates into the old system. Technical experience in this area is that seldom, if ever, does the next generation component fit into the previous system, share the same footprint or works easily with earlier external system interfaces. Those components that do, usually require significant program funding to rehost system software, develop new drivers, update firmware, or customize circuitry to accommodate next generation voltage architectures (i.e. the 5-v transition to 3.3-v or 1.8-v, etc.). In view of these challenges, how will the Army maintain a system for 10 to 15 years when the integrated commercial electronics will be obsolete in 18-24 months and, for the most part, no longer available?

Digitization and Army Transformation

In order to understand the overall complexity of the COTS issue as it relates to fielding schedules and the Army's "unit set fielding" (USF) initiative it is important to understand where we were as an Army and where we are going with transformation. With the end of the Cold War, the Army was forced to take a good look at itself and its relevancy with regard to the type of operations it would

be called upon to respond to in the future. It was clear that as the force was reduced in size, joint operations would become far more important. Operations Other Than War (OOTW) would become the norm, warfare would no longer be fought on a linear battlefield. Network Centric warfare was the future and success hinged on the ability to see and influence the battlefield three dimensionally and at greater distances with fewer forces than ever before. Seamless integration of Command, Control, Communication, and Computer Intelligence (C4I) systems was critical to this new method of warfare. Subsequently, the Army's challenge was to change an acquisition process that at one time supported numerous "stovepipe information systems" (i.e. MCS, AFATDS, CSSCS, etc) and meld it into a functional, interoperational communications architecture. What followed was a series of Advanced Warfighting Experiments (AWE) intended to identify "high payoff" technologies and shake out network C4I shortcomings. From the warfighters perspective, their mission was clear — learn how to use and employ these new information technology (IT) systems to increase the unit's lethality and protection of our forces. But for the Program Managers (PM) on the materiel acquisition side, acquisition transformation introduced a whole new set of challenges, many of which they continue to wrestle with today. First, their programs all have different acquisition strategies and fielding schedules. Second, each program is funded separately, independent of the maturity level of those C4I programs with which it may interoperate. Third, each program is under the control of a different Training and Doctrine Command (TRADOC) training center established to meet

different requirements as laid out in an approved Operational Requirements Document (ORD). To further exacerbate the situation, many of the system ORDs have different environmental performance requirements in spite of the fact that these systems will, in most cases, all have to perform side by side in the same environment.

In early 1999, TRADOC began to work toward producing a Capstone Requirements Document (CRD). Its purpose was to establish a baseline of minimum performance requirements common to all systems operating as a primary Battle Field Area (BFA) software application under the Army Battle Command System (ABCS) umbrella. Currently that document, the ABCS CRD (dated 31 August 2000), serves to guide user requirements and bring consistency with regard to environmental performance parameters and system capabilities.

What exactly is COTS?

COTS information technology refers to a wide range of available hardware and software produced by industry for use in commercial markets. It may refer to board level components built into a product or system, or it may refer to a complete end product or system. Since COTS is produced by the commercial sector, its development and marketing reflect typical commercial priorities such as cost competitiveness, time to market, and the ability to capture market share (percent of the commercial market the corporation/company organization wants to own and control).[5]

When the Army made the decision to use COTS in a tactical environment, no one knew just what the implications of COTS integration might be. Subsequently, the term COTS means different things to different customers. If you ask anyone in the commercial sector to define COTS, their answer will be something you can buy and use "as is" directly from the vendor. DoD has a somewhat different definition however. To DoD, COTS means that an item is manufactured using best commercial practices. The spirit of COTS is to use products, technologies and services that are readily available from industry, without a government or military contractor having to develop them from scratch. [6]

The problem is that there are currently few if any commercial contractors who manufacture computer or automation products , which are sold on the consumer market and can meet Army user requirements "off the shelf" or "out of the box," as defined in an approved Operational Requirements Documents (ORDs) without, in some cases, significant modification. Furthermore, the Operational Test community has shown tremendous reluctance in granting any program relief or negotiating a compromise in key performance parameters (KPPs) as stated in the user's ORD, in spite of how unrealistic some KPPs may be when evaluated in terms of the technical maturity of similar systems in the commercial market. Often this dilemma results in a good program dying a slow but certain death because the old paradigm of tailoring specific military development efforts and high expectations from the user community cannot be met with a pure COTS solution. If they could, the cost to modify or adapt a

COTS technology may prove to be cost prohibitive. In the end, the materiel developer could have provided the user a leap ahead capability and by integrating COTS, keep the cost within available program funding parameters. Instead, the user loses out because COTS "as is" cannot meet the KPP, and developing an objective system which meets all the users requirements is cost prohibitive.

The use of COTS requires a number of trade-offs based upon the environment in which it will be used. The Army Materiel Command (AMC), Communications Electronics Command (CECOM), and subordinates Program Executive Offices (PEO) are aggressively implementing Secretary Perry's vision of COTS integration using a strategy referred to as " Adopt, Adapt, and Develop." [7] Each approach is explored based upon the specific requirement, implementation cost, and development schedule of the product.

The strategy of adopting COTS is certainly the most preferred from both a cost and schedule perspective; however, the majority of all systems required to operate in a field environment must, as stated earlier, undergo some degree of modification or adaptation to meet functionality and reliability requirements. Therefore, the majority of all computer hardware procured and provided to combat units to date has been adapted COTS - components modified or ruggedized to meet clearly defined performance parameters and packaged to meet a specific integration footprint. The term *adapted* refers to the fact that at the board level, components in these tactical computers are pure COTS. However, in order to increase system reliability, robustness and tolerance to a full

spectrum of environmental stresses, a number of manufacturing modifications must take place which may include but would not be limited to the following: exterior casings may be specially designed to absorb impact shock from dropping the item; specially designed removable hard disk drive encasements are developed to reduce the impact of vibration while the system is in use and the combat platform is on the move (a requirement placed in many system ORDs and the ABCS CRD); Electromagnetic Interference (EMI) gaskets and filtering are integrated throughout the complete system; printed circuit boards are stiffened (reinforced); and special mounting arrangements are developed to protect high risk circuitry. Without these modifications few, if any commercial grade computers would survive the demands placed on them in a fully tactical environment. This was evident in the Task Force XXI Advanced Warfighting Exercise conducted at the National Training Center at Fort Irwin in 1997. Most computers, unless modified, cannot meet and perform properly in the low and high-end temperature ranges, vibration, and dust or moisture environments required by most users ORDs. Commercial computers are not designed to meet EMI requirements. This is critical in avoiding co-site interference problems created by placement of an automation system near or adjacent to other operational data transmission devices (i.e. SINGARS, etc). Commercial computers and automation systems are also not designed to survive "High Altitude Electromagnetic Pulsing" (HEMP). This is an electronic enemy countermeasure designed to destroy operational data systems such as the

tactical computer, using a directed high-energy pulse emitted from aircraft or missiles flying over the designated target area.

The point is that COTS implementation should not be strictly interpreted to have the military user believe these systems can meet the demands of combat and network-centric warfare with computers purchased directly from the civilian commercial market without being granted dramatic relief from system performance and reliability requirements as established by the user community.

As one might expect, ruggedizing commercial class automation systems and computers is an expensive endeavor even when it's leveraged by a large (relative to Army procurement) quantity buy. A complete Common Hardware System (CHS) operator's (MCS, CSSS, ASAS, etc.) station with ruggedized computer, flat panel display, keyboard, and software costs approximately $25-30K each. Bear in mind that these systems are contractor supported by way of total system warranties. (More on the CHS system warranty is addressed later in this paper).

When Mr. Perry announced his COTS and acquisition reform initiatives in 1994, commercial technology was turning over every five to seven years. Today that rate of turnover is occurring approximately every 18 months. New microprocessors are entering the commercial market every six months, and next generation memory families every six to nine months.[8] Given this scenario, the maintenance cost can be staggering when you consider that the current defense budget is forcing the services to get longer and longer service life from their systems. In the case of CHS and ABCS systems, the contractor currently carries

this maintenance burden until support ends between 2005 and 2007 (Note— All hardware procured prior to 2001 will be supported through 2005, all subsequent procurement is warranted through 2007) but that only addresses the maintenance of the system not the upgrade (recapitalization requirements). PM's are currently responsible for ensuring they have adequate funds fenced in the POM to support their out-year recapitalization strategies. It is necessary to understand that the strategies may vary from PM to PM based on a number of factors.

Meeting Materiel Requirements with COTS

From the beginning the Army recognized a need for C4I interoperability, both "intra" and "inter" service. At the same time the Army knew it could no longer afford to invest significant funds into developing stovepipe systems to meet each individual user's military system specifications. Mandates for COTS integration, consideration of Cost as an Independent Variable (CAIV), and contract transition to the use of Best Business Practices laid the foundation for what was to become the Common Hardware Software (CHS) Program.

CHS was a significant transition from the old way the Army was doing business in the computer and automated systems arena. The CHS program was established to increase Army Command and Control (C2) interoperability and decrease the cost of acquiring C2 systems. CHS is a contract vehicle which essentially provides PMs and DoD agencies the ability to order computer hardware from a commercial vendor (General Dynamics - Communications

Systems) in one of three categories: pure COTS (Version 1), ruggedized COTS (Version 2), and near mil-spec (Version 3). The CHS program was initiated primarily to provide computer hardware in support of Army Battle Command System (ABCS) and its subsystems (MCS, ASAS, etc). The current CHS-2 contract expires in 2005. The Army is currently in the process of capturing and defining system requirements for CHS-3, a follow-on contract scheduled to begin subsequent to the expiration of the CHS-2 contract in the 2005-2006 timeframe.

Recapitalization: Upgrade vs. Rebuild vs. Rebuy ?

The Army's Recapitalization Program clearly defines and delineates a number of possible approaches toward keeping fielded systems refreshed, relevant and formidable.

- Modernization: The development and/or procurement of new systems with improved warfighting capabilities.
- Recapitalization: The rebuild and selected upgrade of currently fielded systems to insure operational readiness and a zero-time/zero-mile system.
  - Rebuild: Restores a system to like new condition; inserts new technology to improve reliability and maintainability.
  - Upgrade: Rebuilds a systems and adds warfighting capability improvements to address capability shortcomings.
- Maintain: Repair or replacement of end-items, parts, assemblies, and subassemblies that wear or break.[9]

A successful recapitalization plan for Army automation and C4I systems would have to implement more than one of the approaches cited above and in some cases, simultaneously.

Case Study in Recapitalization (Example)

The first rugged computers were delivered to the 4th Infantry Division (4ID) in the mid-1990. These systems had 75 MHz processors, 4 GB hard drives and 256 MB of RAM memory (which was state of the art at that time). Before the 4th ID fielding was completed, the systems being shipped to Fort Hood had migrated to 440 MHz processors, 36 GB hard drives, and 1 GB of RAM memory. This was due to component end of life (EOL) notifications from vendors. Often times these changes come with very little advance notification. This allows the vendors to deplete field supply stockage levels of the components entering obsolescence prior to ramping up inventories of the replacement items. Remaining component inventories are used to repair and maintain legacy systems currently in the field. Prior to the Joint Contingency Force (JCF) Advanced Warfighting Exercise (conducted at Fort Polk) and the Division Capstone Exercise (DCX 1- conducted at Fort Irwin/NTC), almost all PMs fielding systems to 4ID had to upgrade all fielded systems to the current larger hard drive and RAM memory at a cost of $3K+ per box in order for them to run ABCS 6.x efficiently.

Under the current fielding plan, the 1st Cavalry Division and III Corps will be receiving the same (or current) state of the art computer platform as 4ID has now. As we begin to field tactical computers to remaining off-site III Corps units

(i.e. Fort Bliss, Fort Bragg, etc.) and the next digital division or IBCT beginning in 2003, these units will (in all likelihood) receive next generation computer systems which will support up to two (dual) 700 MHz processors, 70+ GB hard drives, and 2 GB of RAM memory. The reason for this ever-increasing difference in system performance is simply that the commercial sector is being forced to meet evolving consumer demands and higher expectations. The difference between a company's success and failure is their time to market window for getting next generation capabilities into the hands of the user. The down side, particularly for DoD, is that very shortly after the commercial sector releases its next generation component or system, it terminates production of the previous generation (End-of-Life). Even if the Army could continue to run software on a low-end system, the parts simply would not be available to procure. Therein lies the problem because, as it stands now, the 4th Infantry Division (the Army's first Digital Division) has little, if any ability, to accommodate growth in the ATCCS systems it currently has, should the ABCS software package, Solaris operating system and/or application (MCS, ASAS, etc) software require additional RAM memory or processor capability. The only recapitalization approach is to buy the newer system.

In view of the Army's inability to control the rapid evolution of computer components in the commercial sector, PMs and TRADOC System Managers (TSMs) will have to adopt a number of strategies to extend the useful life of their systems. This strategy will require influencing hardware development and close

oversight of software and its tendency to grow exponentially with each subsequent version or release package.

With regard to software oversight, the Directorate of Information Systems for C4 (DISC4) working closely with the Deputy Chief of Staff for Operations (DCSOPS), has already taken a major step in addressing this potential problem by developing a software blocking policy. The significance of this initiative cannot be understated. This policy provides executive level oversight and approval authority for migration of ABCS and all related application software release packages. Any new release package, operating system or improvement to ABCS and its sub-components must be thoroughly tested at the Central Technical Support Facility (CTSF), located at Fort Hood, for impact on the system and the network as well as insuring its stability before it is released to units which have been digitized. Furthermore, release of subsequent software release packages will be limited to 18 and 36-month fielding cycles, providing greater stability within the ABCS architecture, reducing operational impact and providing units greater time to train up on the new software prior to implementing the transition.

Recommendations:

Establish a stable software baseline. The recapitalization activity of tactical computer and automation systems will be varied based on a number of factors. In May 2001, the PM, for CHS commissioned a study to evaluate the most probable weak link in our current fielded tactical computer systems.[10] The

analysis showed that the processors (at that time 440MHz), were in most cases almost fully utilized at certain times of operation. The 1GB of RAM memory was found to be more than adequate to support combat operations with the current software. That being the case, units that have already received or will receive those 440MHz systems, which have been purchased, should represent the baseline for software development. Future software releases must be evaluated against this hardware baseline until such time as there is adequate funding to initiate a modernization effort based on a system rebuy for the first generation of fielded systems as these tactical computers can not be upgraded beyond the 440MHz processors which are installed on their motherboards. The migration beyond the 440MHz processor architecture requires a different commercial motherboard.

Conduct trade-off analysis. For systems yet to be fielded to the remainder of the First Digital Corps (FDC) PMs will have tremendous latitude for decisions on how and when to recapitalize fielded systems. Based on information from both General Dynamics -Communication Systems and Sun Microsystems, the next generation of computer motherboards will be able to support two 650-700MHz processors, up to 2 GB RAM memory and house a 73GB removable hard drive – providing ample room for growth in support of future requirements. Cost trade-off analysis will be crucial to determining the cost effectiveness of procuring a next generation system or cannibalizing the legacy systems and incorporating, where appropriate, the older components into the new computer

housing and motherboard. As might be expected this next generation board does not fit into the exterior housing of the tactical computers currently fielded.

Increase funding of SE&I efforts. Increase funding of ABCS system engineering and integration efforts (SE&I). Although application software (e.g. MCS, ASAS, etc.) is being developed to meet individual TRADOC schoolhouse/combat developer requirements for their respective user, the real strength of digitization comes from the synergy created by the seamless integration and interoperability of ABCS subsystems at the Army level. A solid integration process is key to the success of making ABCS and FBCB2 seamless entities. The only way to insure that this happens successfully is through a solid SE&I effort.

Control software growth. Computer hardware and software must be seen as "siamese twins" in that what affects one will surely affect the other. This cannot be emphasized enough! Never lose sight of the fact that the C4I architecture is only as fast and stabile as its weakest link. All software, present and future, will have to run as efficiently on legacy systems sent to the field in the last 3-5 years as it does on next generation systems going out the door today. One of the greatest frustrations for those who develop military oriented computer hardware today is that PMs simply do not know what the minimum hardware requirements are to run the current version of ABCS 6.x (or 7 and beyond). Compound this by adding the Solaris 7.0 operating system (with plans

to migrate to possible 8.0 or 9.0 in the next year or so) then add the BFA application software. Unlike the "minimum system requirements" printed on the side of a box of Windows 98 or 2000, the Army has yet to determine what the minimum requirements are for a using these tactical computers and the myriad of software bundles which form that situational awareness product we refer to as ABCS. As the Army and sister services determine the software requirements for this new network-centric architecture, it is imperative that the CTSF establish "metrics" for determining the minimum and optimum hardware performance requirements to efficiently run ABCS and all additional software. This will allow PMs to know the requirements of hardware needed by soldiers in the future today, and to be able to procure these systems with adequate growth built-in, but at the same time not pay for performance far in excess of what will realistically be needed.

Reduce hardware-software interdependencies. System application software developers often write their software code with a direct dependency on the specific system on which it is being run (e.g. Sun UltraSparc IIi). This should be avoided. Open-architecture should be the standard! There maybe a good rationale for this but it creates a number of problems for PMs. First, any change in hardware platforms or sub-components such as a hard drive (which is inevitable) requires the contractor to modify, change, tweak, or develop the software to make the system continue to run properly. Not only does this take time but it leads to a second problem. Re-porting software to a new platform

can be an expensive proposition if proper preparations and funding adjustments have not been made or planned in advance. Minor software development efforts can cost in the millions of dollars and often far exceed the cost of procuring the new hardware component.

Give Program Managers "cradle to grave" responsibility for their systems. There has been a great deal of discussion as to whether replacement or upgrade responsibility should go to the using unit once fielding has been complete. This approach can lead to significant problems and is not recommended. Decentralizing of recapitalization requirements is the equivalent of herding cats. Every commander would have to plan for his or her system upgrades without being privy to or have control of external forces which might force system migration or maintain interoperability. Funds earmarked for upgrades or rebuy could easily be diverted to meet unanticipated but necessary contingencies. It is conceivable that within a short period of time tactical data communication among major subordinate commands could become tenuous at best.

Make the Central Technical Support Facility (CTSF) the Army's single point of distribution for all ABCS functional and program specific application software. This is important because each product requiring interoperability with ABCS may consist of a number of software release packages scheduled for release over a period of years (e.g., AFATDS Pkg 9, Pkg 10, etc.). The CTSF has the ability and charter to integrate these software packages, work out the

bugs, coordinate the release schedules and analyze software and hardware impact on the total architecture.

The Army and DoD must continue to leverage R&D investments in the commercial sector. PMs, defense contractors and the user community must get together early in the spiral development process to insure that all parties have a clear understanding of "threshold" versus "objective" requirements, how realistic (achievable) they are, and the impact some requirements have on system cost. This would facilitate the identification of a system's functionality or capability which, due to its current lack of technical maturity, may not be realistic to integrate in the near-term but could be met by implementing a "block improvement program" approach in system development, thereby giving the user some leap-ahead capability in the near-term and an objective system consistent with their full requirements in a future block upgrade after the technology has matured to the point where it's ready for the user community.

Conclusion

In just a few short years, the Army has made incredible strides toward transforming into a truly lethal, responsive, and relevant force of the 21st century. Network centric warfare is here to stay and clearly the way the Army will fight most of its adversaries in the future. The Army must continue to exploit the incredible potential of information dominance and refine those systems that will keep it the world's preeminent super power. At the same time, all of these

cutting-edge information systems, high speed C2 networks, and lethal sensor to shooter links still boil down to a soldier drawing a line in the sand and giving his or her life, if necessary, for principles established by this nation long before anyone dreamed of war as we know it today.

The Acquisition Corps has a tremendous responsibility to develop systems that first and foremost provide soldiers with an overpowering advantage over their adversaries and balance this with solid business decisions that will gain the greatest return on invested defense dollars both near and long term.

WORD COUNT: 6,265

ENDNOTES

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